

Appl. No. 10/780,527
Amdt. Dated June 22, 2006
Reply to Office Action of March 24, 2006

Attorney Docket No. 81863.0026
Customer No.: 26021

REMARKS/ARGUMENTS:

Claims 1, 16, 18, 26, and 30 are canceled without prejudice. Claims 2-6, 8, 17, 19, 20, 22-24, 27-29, and 31-33 are amended. Claims 2-15, 17, 19-25, 27-29, and 31-33 are pending in the application. Reexamination and reconsideration of the application, as amended, are respectfully requested.

The present invention relates to a surface-coated member such as a surface-coated cutting tool that is coated with a hard coating layer having excellent chipping resistance and high wear resistance, and particularly to a surface-coated cutting tool that shows high breakage (fracture) resistance and high cutting performance under harsh cutting conditions. (Applicant's specification, at p. 1, lines 11-14).

CLAIM REJECTIONS UNDER 35 U.S.C. § 112:

Claims 1-15 and 25 stand rejected under 37 C.F.R § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. This rejection is moot with respect to claim 1 due to the cancellation of this claim. The Applicant respectfully traverses this rejection as to claims 2-14 and 25.

The Office states that the term "stringer-like" renders the claims indefinite. In response, the Applicant respectfully submits that the term "stringer-like" is well known to one of ordinary skill in the art. However, in order to expedite the prosecution of the instant application, the Applicant deleted the term "stringer-like" from the claims. Withdrawal of this rejection is thus respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. § 102:

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Claims 1-5, 16-21, 23, 24, 26-29, 32, and 33 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Ruppi (U.S. Patent No. 6,251,508). This rejection is moot with respect to claims 1, 16, 18, and 26 due to the cancellation of these claims. The Applicant respectfully traverses this rejection as to amended claims 2-4, 17, 19-21, 23, 24, 27-29, 32, and 33. Claims 2-5 depend from claim 6 which was rewritten in independent form; claims 17, 19-21, 23, and 24 depend from claim 22 which was rewritten in independent form; claims 27-29, 32, and 33 depend from claim 31 which was rewritten in independent form. Claims 6, 22, and 31 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Mitsubishi Material Corp (JP 2000-158205). Claim 6, as amended, is as follows:

A surface-coated member comprising the following (1a) through (1c):

(1a) the surface-coated member comprising a base body, and a hard coating layer comprising at least a TiCN layer and an Al₂O₃ layer formed in this order on the surface of the base body;

(1b) said TiCN layer comprising TiCN crystal that is grown in a direction perpendicular to said base body; and

(1c) said TiCN crystal comprising at least two layers wherein the mean crystal width thereof is larger on the Al₂O₃ layer side than on said base body side, wherein said TiCN layer comprises a carbon-rich TiCN layer located on top of said Al₂O₃ layer side where the ratio C/N of proportions of carbon C and nitrogen N is in a range of $1.5 \leq C/N \leq 4$, and a nitrogen-rich TiCN layer located below the carbon-rich TiCN layer where the ratio C/N is in a range of $0.2 \leq C/N \leq 0.7$.

Applicant respectfully submits that JP 2000-158205 cannot anticipate or render obvious claim 6, because JP 2000-158205 fails to teach or suggest a TiCN

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crystal comprising at least two layers wherein the mean crystal width thereof is larger on the Al_2O_3 layer side than on said base body side, wherein said TiCN layer comprises a carbon-rich TiCN layer located on top of said Al_2O_3 layer side where the ratio C/N of proportions of carbon C and nitrogen N is in a range of $1.5 \leq \text{C/N} \leq 4$, and a nitrogen-rich TiCN layer located below the carbon-rich TiCN layer where the ratio C/N is in a range of $0.2 \leq \text{C/N} \leq 0.7$.

The above constitution makes it possible to improve the adhesion force between the base body, the TiCN layer (the carbon-rich TiCN layer and the nitrogen-rich TiCN layer) and the Al_2O_3 layer, and control the adhesion force of the Al_2O_3 layer in an appropriate range. Consequently, the hard coating film demonstrates high wear resistance without peeling off during continuous cutting operation, and the Al_2O_3 layer absorbs impact by means of microscopic peel-off and cracks even when the coating film experiences sporadic occurrence of strong impact during intermittent cutting operation. This enables it to prevent the Al_2O_3 layer from peeling off over a significant extent and prevent the hard coating film as a whole from chipping or peeling off. Moreover, even after the Al_2O_3 layer has peeled off, since the remaining carbon-rich TiCN layer that has been exposed has high wear resistance, wear does not progress quickly so that the cutting tool I maintains stable wear resistance and breakage resistance. (Applicant's specification, at p. 18, line 17-p. 19, line 3).

In contrast, JP 2000-158205 teaches a TiCN layer which has an upper surface part with a thicknesswise concentration gradient of C and N, which satisfies $x: 0.65$ to 0.95 and a lower surface part with a thicknesswise concentration gradient of C and N, which satisfies $X: 0.65$ to 0.95 when the upper and lower surface parts are exhibited by the following formula: $\text{TiC}_{1-x}\text{N}_x$, and the concentrations of C and N being stepless or stepwise changed. Thus, according to JP 2000-158205, both the

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upper and lower TiCN layers are nitrogen-rich, in contrast, to the present invention which has both a nitrogen-rich and carbon-rich TiCN layer.

In light of the foregoing, Applicant respectfully submits that JP 2000-158205 could not have anticipated or rendered obvious claim 6, because JP 2000-158205 fails to teach or suggest each and every claim limitation. Claims 2-5 depend from claim 6 and therefore, cannot be anticipated or rendered obvious for at least the same reasons as claim 6. Withdrawal of these rejections is thus respectfully requested.

Claim 22, as amended, is as follows:

A surface-coated member comprising the following (2a) and (2b):

(2a) the surface-coated member comprises a base body and a hard coating layer made of at least a TiCN layer and an Al₂O₃ layer formed on the surface of the base body in this order; and

(2b) a TiCN layer, that is observed on the periphery of the base body exposed at the center of an abrasion dent on the surface in Calotest, includes a lower structure where crack width is small or zero, and an upper structure where crack width is larger than that of the lower structure, observed on the periphery of said lower structure,

wherein said TiCN layer comprises at least two layers of a lower TiCN layer where crack width is zero or small observed on the periphery of the base body that is exposed at the center of said abrasion dent, and an upper TiCN layer where crack width is larger than that of said lower TiCN layer observed on the periphery of said lower TiCN layer,

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wherein, when the composition of the TiCN layer is expressed as $Ti(C_{1-x}N_x)$, a value of x is in a range from 0.55 to 0.80 in said lower TiCN layer and in a range from 0.40 to 0.55 in said upper TiCN layer.

Applicant respectfully submits that JP 2000-158205 cannot anticipate or render obvious claim 22, because JP 2000-158205 fails to teach or suggest a TiCN layer is expressed as $Ti(C_{1-x}N_x)$, a value of x is in a range from 0.55 to 0.80 in said lower TiCN layer and in a range from 0.40 to 0.55 in said upper TiCN layer.

When composition of the TiCN layer 24 is expressed as $Ti(C_{1-x}N_x)$, it is preferable that value of x is in a range from 0.55 to 0.80 in the lower layer 35 and in a range from 0.40 to 0.55 in the lower layer 16, namely, composition of the TiCN layer 24 consists of a carbon-rich TiCN layer located on top of said Al_2O_3 layer where the ratio C/N of proportions of carbon C and nitrogen N is in a range of $1.5 \leq C/N \leq 4$, and a nitrogen-rich TiCN layer located below the carbon-rich TiCN layer where the ratio C/N is in a range of $0.2 \leq C/N \leq 0.7$, in order to suppress the progress of the crack 25 generated in the upper layer 36 from propagating into the lower layer 35 and improve the breakage resistance and chipping resistance of the hard coating layer 23. (Applicant's specification, at p. 30, lines 12-20).

In contrast, JP 2000-158205 fails to teach or suggest a $Ti(C_{1-x}N_x)$ layer where a value of x is in a range from 0.40 to 0.55. As discussed above, both ranges for the $Ti(C_{1-x}N_x)$ layers in JP 2000-158205 are 0.65 to 0.95.

In light of the foregoing, Applicant respectfully submits that JP 2000-158205 could not have anticipated or rendered obvious claim 22, because JP 2000-158205 fails to teach or suggest each and every claim limitation. Claims 17, 19-21, 23, and 24 depend from claim 22 and therefore, cannot be anticipated or rendered obvious for at least the same reasons as claim 22. Withdrawal of these rejections is thus respectfully requested.

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Claim 31, as amended, is as follows:

A surface-coated member comprising the following (3a) and (3b):

(3a) the surface-coated member comprises a base body and a hard coating layer comprising at least one TiCN layer formed on the surface of the base body;

(3b) said TiCN layer has, at least in a part thereof, titanium carbonitride grains extend in a direction perpendicular to the surface of said base body and shows a stringer structure when vertical cross section is observed; and

(3c) said TiCN layer includes a fine grained titanium carbonitride layer that shows a needle-like structure extending in random directions when observed on the surface,

wherein the surface of said fine grain titanium carbonitride layer is coated with an upper titanium carbonitride layer of which titanium carbonitride grains have a larger mean crystal width than that in said fine grain titanium carbonitride layer, and surface of said upper titanium carbonitride layer is coated with an aluminum oxide layer,

wherein the thickness t_1 of said fine grain titanium carbonitride layer is in a range of $1\ \mu\text{m} \leq t_1 \leq 10\ \mu\text{m}$ and the thickness t_u of said upper titanium carbonitride layer is in a range of $0.5\ \mu\text{m} < t_u \leq 5\ \mu\text{m}$ while two values of thickness satisfy an inequality $1 \leq t_1/t_u \leq 5$.

Applicant respectfully submits that JP 2000-158205 cannot anticipate or render obvious claim 31, because JP 2000-158205 fails to teach or suggest that the thickness t_1 of the fine grain titanium carbonitride layer is in a range of $1\ \mu\text{m} \leq t_1 \leq 10\ \mu\text{m}$ and the thickness t_u of said upper titanium carbonitride layer is in a

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range of $0.5 \mu\text{m} < t_{\mu} \leq 5 \mu\text{m}$ while two values of thickness satisfy an inequality $1 \leq t_1/t_{\mu} \leq 5$.

It is preferable that thickness t , of the lower structure 31 is in a range of $1 \mu\text{m} \leq t_1 \leq 10 \mu\text{m}$ and thickness t_{μ} of the upper structure 32 is in a range of $0.5 \mu\text{m} \leq t_{\mu} \leq 5 \mu\text{m}$ while both values of thickness satisfy an inequality $1 \leq t_1/t_{\mu} \leq 5$, in order to obtain high adhesion force between base body 22, the titanium carbonitride layer 24 and the Al_2O_3 layer 26, and improve hardness and toughness of the cutting tool 21. Total thickness of the titanium carbonitride layer 24, when formed in a multi-layer structure, is preferably from 8 to 12 μm , in order to suppress peel-off of the film and maintain wear resistance. (Applicant's specification, at p. 36, lines 9-16).

In contrast, JP 2000-158205 teaches a Ti compound layer selected from the group consisting of a TiC layer, a TiN layer and a TiCN layer each having a thickness of 0.1 to 0.5 μm and having a granular crystal structure and a TiCN layer having a thickness of 2 to 15 μm . Consequently, the 0.1 to 0.5 μm range of JP 2000-158205 is outside of the $0.5 \mu\text{m} < t_{\mu} \leq 5 \mu\text{m}$ range taught by the present invention.

In light of the foregoing, Applicant respectfully submits that JP 2000-158205 could not have anticipated or rendered obvious claim 31, because JP 2000-158205 fails to teach or suggest each and every claim limitation. Claims 27-29, 32, and 33 depend from claim 31 and therefore, cannot be anticipated or rendered obvious for at least the same reasons as claim 31. Withdrawal of these rejections is thus respectfully requested.

Claims 1-7, 16-24, and 26-33 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Mitsubishi Material Corp (JP 2000-158205).

This rejection is moot with respect to claims 1, 16, 18, 26, and 30 due to the cancellation of these claims. The Applicant respectfully traverses this rejection as to claims 2-7, 17, 19-24, 27-29, 31-33. These claims include independent claims 6,

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22, and 31 and claims depending from claims 6, 22, and 31. Therefore, claims 2-7, 17, 19-24, 27-29, 31-33 are patentable over JP 2000-158205 for the reasons discussed above. Withdrawal of this rejection is thus respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C § 103:

Claims 8-15 and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ruppi (U.S. Patent No. 6,251,508) or Mitsubishi Material Corp (JP 2000-158205) in view of Nakamura et al. (U.S. Patent No. 5,652,045). The Applicant respectfully traverses this rejection.

Claims 8-15 and 25, as amended, depend from claim 6, and are therefore, patentable over JP 2000-158205 for the reasons discussed above. Nakamura cannot remedy the defect of JP 2000-158205 and is not relied upon by the Office for such. Instead, the Office cites Nakamura for teaching that the elements of a substrate diffuse into lower Ti(C,N) layers having different crystal structure.

In light of the foregoing, Applicant respectfully submits that the cited references could not have rendered claims 8-15 and 25 obvious, because the cited references fail to teach or suggest each and every claim limitation. Withdrawal of this rejection is thus respectfully requested.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (213) 337-6700 to discuss the steps necessary for placing the application in condition for allowance.

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If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

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